Physics UN2802 | Professor Christ
due 02/18/2021

Assignment #16

Reading:

Mar 05 Purcell Chapter 7.5-7.10
Mar 07 Purcell Chapter 8.1-8.3

Problems:

133. Purcell 6.30

134. Purcell 6.38

135. Purcell 7.1

136. Purcell 7.3

137. Purcell 7.4

138. Purcell 7.7

139. Purcell 7.9

140. Purcell 7.15

141. Rework your solution to problem #132 to solve a similar problem with a single line of charge with linear charge density $Q = 2$ esu/cm inside a conducting tube whose cross section is shown in the diagram to the right. The coordinates give the locations of the corners of the tube and the single line of charge in units of cm. Draw a plot showing equi-potential lines in the two-dimensional rectangle $0 \le x \le 10$ cm, $0 \le y \le 10$ cm, $z = 0$ cm. Show lines corresponding to 51 values for ϕ lying between $\phi = 0$ esu/cm and $\phi = +15$ esu/cm separated by 0.3 esu/cm and use a numerical grid with grid spacing of 0.05 cm in both the x and y directions. Work with a precision corresponding to at least 15,000 ordinary relaxation steps. (As with problem #132 you can follow the pattern of the Python example posted on the course website:
http://www.columbia.edu/~nhc1/UN2802/Python/Python_index.htm labeled "`Potential-in-box.ipynb`" and then gradually modify it to become the solution to the problem posed here. It is wise to set the potential to zero everywhere as the first step. The assignment of potential values to the more complex boundary in this problem requires that each of the two original for loops be broken into three pieces. Finally the relaxation can be done in the full 10 cm × 10 cm cross section if you simply add the condition `if(nx*Dx < 6 or ny*Dy < 6)` to the relaxation step to prevent the potential from being changed in the upper corner.)